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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/FI98/00561 <b>(22) International Filing Date:</b> 26 June 1998 (26.06.98) <b>(30) Priority Data:</b> U970331 15 July 1997 (15.07.97) FI <b>(71) Applicant (for all designated States except US):</b> VALMET CORPORATION [FI/FI]; Panuntie 6, FIN-00620 Helsinki (FI). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> RATA, Ilkka [FI/FI]; Vitsiälänkatu 4, FIN-40520 Jyväskylä (FI). LEHTONEN, Pentti [FI/FI]; Majantie 6 B 13, FIN-40250 Jyväskylä (FI). TELAMA, Ari [FI/FI]; Eemelinukuja 6, FIN-40520 Jyväskylä (FI). <b>(74) Agent:</b> FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).		<b>(81) Designated States:</b> AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> <i>In English translation (filed in Finnish).</i>
<b>(54) Title:</b> BLADE FOR A DOCTOR IN A PAPER/BOARD MACHINE AND METHOD FOR SIMULTANEOUS COATING AND DOCTORING OF A ROLL IN A PAPER/BOARD MACHINE		
<b>(57) Abstract</b>  The invention concerns a blade of a doctor for a roll in a line of manufacture of paper/board, which blade of a doctor comprises a polymer material and optionally a fibre reinforcement. By means of the blade of a doctor, doctoring and coating of the roll with a material that repels impurities are carried out at the same time.		

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Blade for a doctor in a paper/board machine and method for simultaneous coating and doctoring of a roll in a paper/board machine

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The invention concerns a blade for a doctor in a paper/board machine, which blade contains compounds that repel impurities and removes any undesirable material from the face of a roll and, at the same time, coats the roll with said compounds.

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The faces of rolls in a paper/board machine tend to be coated with impurities coming from the process and with undesirable material of a doctor blade and to be scratched and abraded as a result of doctoring. For removal of undesirable material from the roll faces, doctor blades are employed.

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Problems occur in particular in the surface properties of rolls coated with ceramic materials, for example, the surface energy of the roll is too high, in which case the properties of detaching of the paper web are inadequate, detrimental pores are present in the coating, or the face has been damaged as a result of abrasion.

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Attempts have been made to solve these problems by means of polymers that contain fluorine, because fluorine atoms contained in a polymer structure are highly electro-negative and have a lowering effect on the surface energy, in which connection the properties of detaching of the web are improved and contamination of the roll is reduced.

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In the *FI Patent 93,183*, a method and a device are described for application of a fluoroplastic onto the face of a roll in a paper machine. The application of the fluoroplastic takes place by press polishing so that a fluoroplastic disk or bar is pressed against the face of a revolving roll. By means of a fluoroplastic beam, the roll face is press polished, and in this way the properties of detaching of the web are improved and the problems of contamination are reduced. A fluoroplastic beam can be mounted in the holder of a doctor, but even then it is used for fluorine treatment

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of the roll face only, and not for doctoring. If it is desirable to use the press polishing method for application of fluoroplastic to the face of a roll, either an extra holder must be installed, which holder permits continuous press polishing, or the doctor blade in the holder of the doctor must be replaced by a piece made of fluoroplastic. The acquisition, installation and operation of a separate apparatus  
5 meant for press polishing cause additional costs, and the operation requires a working step of its own. On the other hand, when mounted in the place of a doctor blade, fluorine treatment of the face with a piece made of fluoroplastic is not possible as a continuous operation. In practice, press polishing is mechanical rubbing  
10 of the roll face with a piece of fluoroplastic, and adhering of the fluoroplastic to the roll face varies to a considerable extent, in particular if the roll face is contaminated or it involves other heterogeneity. Also, fluoroplastic adheres to a cold roll face rather weakly and does not stick to the face evenly.

15 The object of the present invention is a blade of a doctor for rolls in a line of manufacture of paper/board, which blade, at the same time, removes contaminations and undesirable material from the roll face and coats the roll face with a compound that repels impurities continuously, as well as a method for simultaneous doctoring and coating of a roll with a compound that repels impurities.

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The above drawbacks involved in the prior art can be eliminated and the objectives defined above can be achieved by means of a doctor blade in accordance with the present invention for a paper/board machine, which is characterized in what is defined in the characterizing part of the patent claims.

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In the following, the invention will be described in more detail.

A doctor blade in accordance with the present invention comprises a binder matrix and a coating matrix.

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The binder matrix consists of a thermosetting resin or of a thermoplastic resin. Examples of suitable thermosetting matrix plastics are epoxy resins, polyesters, vinyl

esters, acrylates, methacrylates, and copolymers and terpolymers of same and their mixtures. Examples of suitable thermoplastic matrix resins are polyamides (P46, PA6, and PA66), polyphenylene sulfide, polyether ketone, polyether-ether ketone, polyester thermoplastic resin, polyphthalamide, polyetherimide, polyether sulfone, polysulfone, etc. thermoplastic materials with good resistance to heat, together with their copolymers and terpolymers and mixtures of same. The binder matrix is preferably reinforced with a suitable reinforcement, which includes, advantageously, carbon fibre, fibreglass or boron fibre reinforcements, preferably as an oriented fibre or discontinuous fibre.

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The doctor blade also comprises a coating matrix, which is made of a material that repels impurities, favourably of a halogen polymer compound, which is brought into connection with the binder matrix by physical or chemical means. The doctor blade contains 0.5...50 %, preferably 0.5...10 %, of coating matrix. The coating matrix is favourably mixed with the binder matrix in particle form, preferably by dispersing into the matrix mix. An advantageous coating matrix contains a fluoropolymer, for example FEP, PFA, PTFE, ETFE, etc.

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It is essential in the selection of the binder matrix and the coating matrix that the melting point of the binder matrix must be equally high as, or higher than, the melting point of the coating matrix. Friction heat that arises in the doctoring process produces melting of the polymer material at the tip of the doctor blade, as a result of which the molten polymer material is separated from the blade and adheres to the roll face, at which the temperature is lower than at the tip of the blade, in which connection the polymer solidifies onto the roll face. In order that the roll face were coated mainly with the coating polymer that repels impurities, and not with the binder matrix, the melting of the coating matrix must take place first, i.e. its melting point must be lower than the melting point of the binder matrix. When a thermosetting plastic matrix is used, also the same melting point can be permitted, because thermosetting plastic starts decomposing at its melting point. The melting point of coating matrix materials is preferably in the range of about 180...250 °C, and the melting point of binder matrix materials equally high or higher.

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When particle mixing is used, the particle size also affects the final result in order that a sufficient sintering on the roll face could be achieved. As the rate of wear of the blade is typically about 100...150  $\mu\text{m}$  per hour, a suitable particle size is 40...120  $\mu\text{m}$ , preferably about 60...90  $\mu\text{m}$ , in order that the friction heat should be sufficient for melting the particle and that the particle should be detached from the blade in the molten state. With a particle size substantially larger than this, the detaching from the blade becomes more difficult, and, on the other hand, with a substantially smaller particle size, the formation of the desired film that repels impurities on the roll face becomes more difficult.

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The coating matrix can optionally also be prepared so that the binder matrix is subjected to a fluorination treatment under such conditions that oligomer chains and/or polymer chains that contain fluorine are immobilized in the polymer structure of the binder matrix by means of physical or chemical bonds. As examples of fluorine compounds that are used for fluorination can be mentioned fluorinated macro-oligomers, diols, triols, thiols, and/or polyols, as well as their adducts with various anhydrides.

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The doctor blade is manufactured preferably by means of a pultrusion process.

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When the solution in accordance with the present invention is employed, a material that repels impurities, preferably a fluoropolymer, can be applied to the face of a roll in a paper or board machine in the structure of a well operating doctor blade without loss of the doctoring properties of the doctor blade itself. By means of this method, the roll can be coated in a controlled way and homogeneously with a material that repels impurities. A fibre-reinforced composite doctor blade has excellent doctoring properties, which are also essential in order that the coating process could be carried out successfully. In the coating process, friction heat is utilized, by whose effect the fluoropolymer can be sintered onto the roll face. This can be intensified further momentarily by making use of what is called dry running, which can be carried out in the dry end of a paper or board machine preferably at intervals of one or two weeks, and with press rolls more frequently.

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What is concerned is coating taking place by means of a doctor blade, wherein the blade has an efficient knife effect, which is permitted by the carbon-fibre or carbon-fibre/fibreglass reinforced composite blade. Onto the roll face, a material that forms a new release film is introduced constantly while, at the same time, contaminations are removed, which contaminations can be detached readily by means of the blade from the surface of the release film. Of course, all components of the matrix material adhere to the roll face, but the material that repels impurities, preferably fluoroplastic, is sufficient to produce a desired change in the surface energy values of the roll in a controlled way.

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A doctor blade in accordance with the invention can be used for applications of doctoring of rolls in lines of manufacture of paper, rolls in a line of manufacture of board, and of rolls in printing machines and, in general, for simultaneous coating and doctoring of a revolving roll or a moving face in order to prevent contamination.

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It is easy to replace the doctor blades, and there can be one or several blades depending on the sorts of the effects that are desired. It is an important advantage of the present invention that, at the same time, contaminations and undesirable material are removed from the roll face, and a caring coating is applied with a material that repels impurities without having to stop the process and without any separate apparatuses for application of the material that repels impurities. The material that repels impurities and that has been transferred to the roll face improves the properties of detaching of the web and the properties of strength and the properties of resistance to corrosion of the roll coating and reduces the contamination of the roll.

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## Claims

1. A blade of a doctor for a roll in a line of manufacture of paper/board, **characterized** in that, by means of the blade of a doctor, doctoring and coating of the roll  
5 with a material that repels impurities are carried out at the same time.
2. A blade of a doctor as claimed in claim 1, **characterized** in that the material that repels impurities is melted by means of friction from the doctor blade onto the roll face in connection with the doctoring process.  
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3. A blade of a doctor as claimed in claim 1 or 2, **characterized** in that the doctor blade comprises a polymer material and optionally a fibre reinforcement.
4. A blade of a doctor as claimed in any of the claims 1 to 3, **characterized** in that  
15 the polymer material contains a binder matrix component, which consists of a thermoplastic or thermosetting polymer, and a coating matrix component consisting of a material that repels impurities.
5. A blade of a doctor as claimed in any of the claims 1 to 4, **characterized** in that  
20 the melting point of the binder matrix is the same as, or higher than, the melting point of the coating matrix.
6. A blade of a doctor as claimed in any of the claims 1 to 3, **characterized** in that the binder matrix consists of a halogen polymer, preferably fluoropolymer, mixed  
25 with the binder matrix, the particle size of said halogen polymer being 40...120  $\mu\text{m}$ , preferably 60...90  $\mu\text{m}$ .
7. A blade of a doctor as claimed in claims 1 to 4, **characterized** in that the binder matrix consists of thermosetting plastic, and the coating matrix has been prepared so  
30 that the binder matrix has been subjected to a fluorination treatment.

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8. A method for simultaneous doctoring and coating of a roll in a line of manufacture of paper/board with a compound that repels impurities, **characterized** in that the doctoring is carried out by means of a doctor blade as claimed in any of the claims 1 to 7.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 98/00561

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
IPC6: D21G 3/00, B29C 33/58 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
IPC6: D21G, B09C, B05D, B05C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE,DK,FI,NO classes as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EDOC, WPI		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FI 93183 B (VALMET PAPER MACHINERY INC.), 30 November 1994 (30.11.94), abstract, claims --	1-3,5-8
A	DE 4137970 A1 (STORA FELDMÜHLE AG), 27 May 1993 (27.05.93), column 1, line 66 - column 2, line 3; column 1, line 18 - line 21, claims --	2-4
A	US 4119990 A (PAUL B. MASON ET AL), 10 October 1978 (10.10.78) -- -----	1,8
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